robust and rather short. The distal keels of the former are posterior and rudimental; their proximal extremities have a small lateral tarsal facet as well as the principal one. The median digits are of unequal length, and the lateral ones are much shorter, but robust. Whether there are four or five digits I cannot definitely ascertain.

The above characteristics are very significant. They at once refute any supposition of affinity to the Artiodactyla, whether suilline or ruminant. The form of the astragalus and wide fibular condyle of the calcaneum opposes the reference of the genus to the Perissodactyla. On the other hand, all the characters of the feet thus far adduced are found in the Proboscidea. They are not only those of that order, but they are carried to a degree of exaggeration, as though *Toxodon* represented a high grade of specialization of that order. The posterior feet were more truly plantigrade, for the extremity of the calcaneum reached the ground, while the instep was elevated above it, being supported, no doubt, by a more or less elastic pad. This arched or angulate plantigrade type of foot has a remote parallel in that of man. It is quite unique among ungulate Mammalia.

What difficulties the other parts of the skeleton may present I do not yet know, but I perceive nothing in the dentition which forbids the reference of *Toxodon* to the Proboscidea. The dentition is scarcely more different from that of *Mastodon* or *Dinotherium* than that of *Bos* is from *Dicotyles* or *Hippopotamus*. The former genera may be the extremities of a series whose intermediate members are as yet undiscovered. In the latter case the intermediate forms are mostly known.—*Proc. Amer. Phil. Soc.*, April 15, 1881, p. 402.

Contributions to the Study of the Flagellata. By M. J. Kunstler.

Cryptomonas ovata, Ehrbg., presents at its superior terminal part a narrow cavity extending from the dorsal to the ventral surface, and forming a sort of vestibule of the digestive tube. At the boundary of the left surface and the anterior surface of the body there is an emargination of the margin of this vestibular cavity, which descends to about one fifth of its length, and thus passes the bottom of the cavity, which is not deep. The two flagella are inserted in the centre of this cavity, at the bottom of a tube which projects from its interior; they present a distinct *transverse striation*, and absolutely resemble a muscular fibrilla. I have observed an analogous striation in several other forms, such as *Euglena oxyuris*, *Trachelomonas hispida*, *Phacus pleuronectes*, *Chlamydomonas pulvisculus*, *Chilomonas paramœcium*, *Astasia costata*, and *Entosiphon costatum*. In *Chlamydomonas pulvisculus* only two flagella are described; but in reality there are four. In *Trachelomonas hispida* the enormous flagellum, which is so striking, is the only one known, while at its base there are two other analogous organs which have not been described; they are much shorter and more delicate. The

two terminal flagella of *Cryptomonas ovata* serve exclusively for locomotion.

Besides these terminal locomotory organs, there are further in these creatures a whole group of flagella the existence of which has hitherto been entirely unknown. Along each of the two margins of the superior emargination there exists a series of these appendages almost as long as the others, but of excessive fineness and transparency; they are also striated. These organs serve exclusively for the prehension of food.

The walls of the body are composed of *four layers*, the outer one of which alone (the cuticle) is colourless, while the others are impregnated with chlorophyll.

In the deepest of them there are polygonal grains of starch, which, when well developed, nearly touch each other by their edges, and give to the creature a reticulate aspect. Its inner surface presents a regularly mamillated appearance, and the gibbosities observed upon it appear to be an indication of an actual division of the substance of this layer into small protoplasmic spheres; each of them produces a grain of starch in its interior. Sometimes certain mamillæ become elongated and then constricted in the middle, finally forming new mamillæ. The peripheral material of these protoplasmic spherules is much more dense and resistant than that of the centre, which appears to be absolutely aqueous, for the fine granules which occur there are frequently animated by a Brownian movement, and thus each of them presents in its interior a large vacuole. This deep-seated layer of the integument is not much coloured, and its thickness varies considerably, according to the part of the body that is examined; it is even completely deficient at certain points. The grains of starch which are produced in it have the form of thin polygonal lamellæ; they also divide at the same time as the mamilla that has produced them.

The other two tegumentary layers, which are much thinner, are perforated by a multitude of extremely small vacuoles, filled with an aqueous protoplasm, regularly arranged, and separated from each other simply by thin portions of a denser substance. The cuticle which forms the outermost envelope of the body presents an analogous structure; but the small vacuoles are much flattened parallel to the surface of the body.

The œsophageal tube which has been described in *Cryptomonas* has no existence; but, on the other hand, we find in these creatures a spacious *stomach*, well defined, in which the food is digested. The *walls* of this organ are thick, and present a remarkable appearance; throughout they show numerous close-set granules arranged in a single layer and forming regular rectilinear series; these are starch-grains. In certain cases, when these granules are absent, we can easily see that the protoplasm forming the stomachal walls presents a regularly vacuolar structure, and does not owe its remarkable aspect only to the presence of these grains. At the bottom of the stomach is the origin of a tube, which is the intestine, and which terminates at the anus, which is situated at the lower extremity of the body

towards the dorsal surface. Contrary to the generally received opinion, according to which the *Cryptomonades* only absorb liquid food, there are frequently in their digestive tube small creatures upon which they feed.

The contractile vesicle *communicates with the exterior by a pore* opening into the interior of the canal projecting from the bottom of the digestive vestibule; it has distinct, vacuolar proper walls, like those of the stomach; from its lower part there issues a transparent canal which soon loses itself.

The nucleus, the substance of which possesses a regularly and finely vacuolar structure, like that of the integuments, usually possesses a *certain number of nucleoli*, around each of which the surrounding substance seems to be massed; these vesicular corpuscles divide transversely, pretty actively, and frequently we see some of them surrounded by a zone of clear protoplasm, projecting at the surface of the nucleus, and finally detaching themselves completely and falling into a special cavity; these are germs, a part of the development of which takes place in this cavity. It consists of a tube commencing at the bottom of the vestibular duct, soon dilating into an incubatory chamber, and terminating at the nucleus.

Above the stomach, in front and to the right of the nucleus, there is a large mass of protoplasm with a finely vacuolar structure and remarkably distinct, within which are distributed a certain number of corpuscles resembling nucleoli, and from which starts a tube which terminates at the vestibular duct. It is an excretory organ or a male apparatus; and the latter hypothesis is rendered probable by the fact that in these creatures there occurs a sort of copulation, in which they adhere together, two by two, and mouth to mouth, and in this way wander about freely.

In order to investigate the oculiform point of the Flagellata I selected an organism in which this organ is usually well developed, namely *Phacus pleuronectes*, Dujard. Starting from the observation that in individuals brought up in a certain obscurity the oculiform point was but little developed, I assumed *à priori* that an intense light would, on the contrary, be favourable to its development, and I made these creatures live in a strong light. The result of this arrangement was that I obtained individuals with the oculiform point large, brilliant, and very red. This organ is formed by a collection of red granules, irregularly pyriform in shape, and with the enlarged extremity turned always in the same direction; the pigment which colours them is diffused only over their surface, while their internal substance is hyaline. All these granules are arranged side by side upon a curved plane; in the concavity thus formed there is lodged a transparent, refringent, lenticular corpuscle. Judging from this structure it seems to me that the visual functions of the oculiform point can no longer be doubted*.—*Comptes Rendus*, Oct. 17, 1881, p. 602.

* As *Cryptomonas ovata* is only about ·04 millim. in length, it is a pity that M. Kunstler has not informed us with what sort of microscope and under what power he was enabled to arrive at such extraordinary results.